USE OF WASTE TYRE IN FLEXIBLE ROAD PAVEMENT

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Abstract : This Natural material are limited in nature due to which quantity of natural materials are decreasing and its cost is increasing.Concerned about this,Engineers are looking at alternative material for highway construction by which quality of road is increased with low cost.In present scenario, the use of automobile is significantly increased due to which the quantity of waste and scrap also increased. Keeping in mind , the need for use of bulk quantity of solid waste in India,it was thought to test these materials and develope specifications so that we can enhance the use of waste tires in road making from which higher economic returns may be possible.Crumb rubber which is obtained from waste tyres can be , where we melt the crumb rubber with bitumen and mixing it with various percentage of CR.In this paper ,an attempt is made to know what percentage incorporation of crumb rubber to bitumen , upgrade the strength and durability of pavement.To know the quantity of rubber replacement in pavement and to know the variations in strength parameters by conducting different tests. The use of waste tyres in construction of road pavement helps to reduce noise pollution occurs during heavy traffic due to friction and so on. Materials that are use is Bitumen VG-30,asphalt and tyres rubber crumb.Methodology to achieve this project is marshal stability test and common test that is to be done in aggregate and asphalt and expected outcomes will be properties of bitumen such as softening point ,flash point ,fire point increases with addition of waste crumb rubber. Ductility value decreases with increase in percentage of modifier (rubber pieces). This modified bituminous mix can bring real benefits to highway construction, maintenance in terms of better and longer lasting roads and savings in total road life casting.

Index terms : AC – Asphalt Concrete , CRMB - crumb rubber modified bitumen , CR – Crumb Rubber.

1.INTRODUCTION

In the age of dynamic economic process, when people strive to attain perfection altogether aspects of their lives, in times of unprecedented advance in technology and automobilism road infrastructure is becoming increasingly important .A key problem faced by modern societies is that the continuously increasing number of vehicles. There is a growing interest in research into new modified binders whose properties would improve technological qualities of structural courses of road pavements. Roadways are an integral aspect of transportation infrastructure. Construction engineers must consider the first user's requirements of safety furthermore because the economy. To realize this goal, designers should take into consideration three fundamental requirements which include environmental factors, traffic flow, and asphalt mixtures materials. In asphalt concrete (AC), bitumen as a binder serves two major functions in road pavement, first, to carry the aggregates firmly and second to act as a sealant against water. However, because of some distresses like fatigue failure, the performance and sturdiness of bitumen are highly plagued by changes with time in terms of its characteristics which may result in the cracking of pavement Disposal and utilization of used tires still remain a problem with major environmental implications, because the needs of modern lifestyle are causing increase on their volume. Not surprisingly, larger quantities of used tires are generated in countries like Germany, UK, France, Italy, Spain and Poland with a variety between 250 and 600,000tons p.a. All other countries generate 100,000 tons p.a., while six countries generate 15,000 tons or less. The crucial environmental problem of tires disposal has led European legislation to ban the disposal and land filling under the Directive 31/99/CE Global environmental awareness normally, and particularly in engineering sector has led scientists in search of other uses like manufacturing of latest re-treaded tires, in docks and marinas as corrosion - preventing from waving materials, for the assembly of road equipment and signing, in playgrounds or football fields. Rubberized asphalt is another recovery option of EOL tires, providing environmental friendly thanks to reduce primary aggregate materials in pavement construction. Crumb rubber is typically recycled rubber which is obtained from waste tires. Within the recycling process, the steel and also the tire cords are removed and tire rubber is separated. This is often done either mechanically or by using cracker mill. Crumb rubber is extremely suitable to be the used as an additive in pavement because it's the characteristic which will support the weakness of asphalt. It not only enhances the properties of bitumen but also addresses serious environmental pollution issues. the idea of this study is to offer an overall idea to students regarding waste disposal and the way this waste disposal problem are often addressed effectively without harming the environment Waste tyre rubber has been used due to its elastic properties which had the potential to boost the skid resistance and sturdiness of asphalt mixtures [1-3]. The extra good thing about using rubber in asphalt mixtures was that it created another or additional use of recycled waste tyres.

2. RESEARCH METHODOLOGY

2.1. MATERIALS

2.1.1 Selection of Rubber:

Waste rubber tyres were collected from roads sides, dumpsites and waste-buyers. The collected waste tyres were sorted .As per the specified sizes for the combination. The waste tyres were cut within the kind of aggregate of sizes starting from 0.15Mm to 5mm (as per IRC-SP20) within the tyre cutting machine. The waste rubber tyres may be managed as a full tyre, asslit tyre, as shredded or chopped tyre, as ground rubber or as a crumb rubber product.

The methodology section outline the plan and method that how the study is conducted. This includes Universe of the study, sample of the study,Data and Sources of Data, study's variables and analytical framework. The detailsare as follows;

2.1.2 Selection of aggregate:

Aggregates which have been used in this specimen is 10 mm downgrade aggregate and 6 mm downgrade aggregate.

2.1.3 Selection of bitumen binder: binder used in this test specimen is VG – 30.

2.2.TESTING ON CRUMB RUBBER

2.2.1. SIEVE ANALYSIS

Sieve in (mm)	Retained on each sieve (gm)	Cumulative mass of rubber retained	Cumulative mass of rubb
4.76	4.39	4.39	195.61
2.36	48.2	52.59	147.41
1.18	33	85.59	114.41
0.6	33.8	119.39	80.61
0.3	35	154.39	45.61
0.15	32	186.39	13.61
0.075	1.8	188.19	11.81
Pan	11.81	200	0

2.3 TESTING OF AGRREGATE:

2.3.1 Impact value test –

AGGREGATE IMPACT VALUE TEST IS -2386 PART -IV

MATERIAL : Corase Aggergates. mm passing & 10 mm retained).		Date of sampling : (12.5 Date of Testing :
OBSERVATION DATA		
Description	TEST - 1	TEST - 2
Weight of empty cup = W-1 (Gms)	-	-
Weight of empty cup + Sample = W-2 (Gms)	333.6	333.4
Net weight of Sample (W-3) (Gms) = W2 - W1	333.6	333.4
WT of sample passing 2.36 mm sieve = W4 (Gms)	60.5	67.6
WT of sample retained 2.36 mm sieve = W5 (Gms)	272.5	263.2
Aggergate Impact Value (%) = W4 X 100	18.13	20.27
Average Aggergate Impact Value (%) =	19.2	19.2

2.3.2 Los Angeles abrasion test

Sr.No.	Determination	Specimen-I		Specimen-II	
		10 MM	6.3 MM	6.3 MM	4.75 MM
1	Size of aggregate (mm)	10 to 6.3		6.3 to 4.75	
2	Grade of Sample	C		C	
3	No. of Spheres	8		8	
4	Weight of Sample (gms)	5000		5000	
5	No. of revolutions	500		500	
6	Weight of retained on 1.7 mm sieve	3996		4148	
7	Weight of passing 1.7 mm sieve	1004		852	
8	Los Angeles Abrasion (%)	20.08		17.04	
9	Average los Angeles Abrasion Value (%)	18.56		18.56	

2.4 TESTING OF BITUMEN:

2.4.1. Penetration test –

VG 30	**Penetration Test**			
Crumb rumber	**Test 1**	**Test 2**	**Test 3**	**Average**
	Initial			
	0	0	0	
0%	48	53	56	52.5
5%	47	53	55	51.67

8%	45	50	53	49.33
11%	47	48	51	47.67
14%	44	47	50	47

2.4.2. Softening test

Procedure:

Crumb rumber	Ring 1	Ring 2	Average
0%	53 C	54 C	53.5 C
5%	57 C	58 C	57.5 C
8%	61 C	61 C	61 C
11%	64 C	63 C	63.5 C
14%	65 C	65 C	65 C

2.5 Marshall stability test

Test is conducted on compacted cylindrical specimens of bituminous mixes
(1) Normal Bituminous mix and
(2) Bituminous mix with 5% of Crumb Rubber by the weight of bitumen
(3)Bituminous mix with 8% of Crumb Rubber by the weight of bitumen
(4)Bituminous mix with 11% of crumb rubber by the weight of bitumen
(5)Bituminous mix with 14% of crumb rubber by weight of the bitumen , of diameter 101.6 mm and thickness 63.5 mm. The load is applied perpendicular to the axis of the cylindrical specimen through a testing head consisting of a pair of cylindrical segments, at a relentless rate of deformation of 51 mm per minute at the quality test temperature .

Preparation of test specimen:

- Heating the desired weight of the mixed aggregates to the required temperature • Heating the desired weight of rubber crumb to a required temperature.
- Melt the required bitumen at certain temperature and mix the melted desired weight of rubber crumbs with bitumen
- Heating the specified weight of the bituminous binder to the required temperature
- Mixing the aggregates and also the binder within the laboratory mixer at the required mixing temperature counting on the sort and grade of the bitumen, specified aggregates are fully coated with bitumen (CR – 0% by weight of bitumen) and by changing CR value as 5% , 8% , 11% , 14 %. Mix the sample one by one and specimens are made.
- Transferring the recent mix to the mould and compacting as laid out in the test method
- Removing the test specimen from the mould and cooling to temperature
- a minimum of three test specimens are prepared at each trial bitumen content in order that mean of three consistent test values can be utilized for determining the
- mean value .

	Crumb rubber %	Weight in air (W1)	Weight in water (W2)	SSD Wt.(W 3)	(W3W2)	Bulk density gm/cc	Proving ring	Factor of correction	Marshal stability	Flow value
1	0	1204	693	1208	515	2.34	265	1	1348.85	3.8
2		1215	694	1217	523	2.32	280	0.96	1368.19	3.6
3		1213	699	1219	520	2.33	260	1	1323.4	3.8
4	5	1215	697	1220	523	2.32	250	0.96	1221.6	3.2
5		1203	697	1208	511	2.35	245	1	1247.05	3.1
6		1196	686	1201	515	2.32	255	1	1297.95	3.2
7	8	1210	694	1217	523	2.31	260	0.96	1270.46	3.6
8		1193	689	1199	510	2.34	270	1	1374.3	3.6
9		1211	695	1218	523	2.31	270	0.96	1319.3	3.4
10	11	1218	702	1222	520	2.34	310	1	1577.9	3.1
11		1206	696	1204	513	2.35	320	1	1628.8	3.1
12		1219	707	1225	518	2.35	315	1	1603.35	3.3
13	14	1202	695	1210	515	2.33	275	1	1399.75	3.0
14		1217	709	1226	517	2.37	265	1	1348.85	3.3
15		1198	692	1206	514	2.33	260	1	1323.4	3.2

3. CONCLUSION AND DISCUSSION

The values of various parameters i.e. Softening point, Penetration and Marshall stability within the cases of crumb rubber modified bitumen have discovered to be within required specifications. It's observed crumb rubber modified bitumen reveals that the Marshal Stability value, which is that the strength parameter of bituminous concrete, has shown decreasing trend from 0% to 5% and so marshal Stability value shows increaing trend from 5% to 11% and decreasing trend from 11% to 14% and so on ,the maximum value we have received on 11% CR by the weight of bitumen w.r.t 0% CR . It's concluded from the experiment that the upper crumb rubber content results in higher softening point ,also it concluded that increase in higher Crumb rubber content ends up in lower penetration values .This experiment won't only constructively utilize the waste tyres in construction industry but also effectively enhance the important parameters which can ultimately have better and long living roads. This may provide more stable and sturdy mix for the flexible pavements. Thus, these processes are socially highly relevant, giving better infrastructure

SR No.	Crumb rubber %	Bitumen %	Softening point	Penetration	Marshal stability Kg	Flow value
1	0	6	53.5	52.5	1346.81	3.7
2	5	6	57.5	51.67	1255.53	3.15
3	8	6	61	49.33	1321.36	3.5
4	11	6	63.5	47.67	1603.35	3.2
5	14	6	65	47	1357.33	3.1

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